Abstracts

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S. HAYASHI: **Wood Anatomy and Wood Quality——Biodeterioration and its influences on the Wood as a Raw Material.** Mokuzaikenkyu·Shiryo (Wood Research and Technical Notes), No.**15**, 1 (1981). (in Japanese)

Anatomical features of wood are varied during biodeterioration. When the cell wall, for example, becomes thinner by fungal attack, the specific gravity and/or strength of wood becomes smaller. The relationship between the biodeterioration and the wood quality (external appearance, strength, thermal and electrical properties, permeability, drying, pulping etc.) are summerized from the anatomical point of view.

T. ITOH, K. YAMAGUCHI, H. KURODA, K. SHIMAJI and K. SUMIYA: **The Influence of Planting Density on the Wood Quarity of Sugi and Hinoki.** Mokuzaikenkyu·Shiryo (Wood Research and Technical Notes), **15**, 45 (1980). (in Japanese)

The influence of the initial planting density on the ontogenetic variation of tracheid length, ring width, late wood ratio, micellar angle and cristallinity of cellulose, dynamic elastic modulus in bending and basic density were compared among 4 and 3 different planting densities for Hinoki (17 years old) and Sugi (40 years old), respectively. Fundamental tendencies of the response for higher planting densities were considered to be as follows: a) tracheid length is shorter but stabilized earlier, 2) ring width is narrower and stabilized earlier, 3) late wood ratio is larger, 4) basic density is larger, and 5) dynamic elastic modulus in bending is also larger. The merits of high or low planting densities for wood qualities were briefly discussed.

T. KISHIMA, M. SHIMAKURA and S. HAYASHI: **Identification of Wooden Treasures of Shousouin.** Annual Report of Shousouin, No.**3**, 1 (1981). (in Japanese)

There are many forms in wooden treasures; arms, Buddhistic instruments, musical instruments, joineries, turneries, scrolls and wooden pieces. The wood species of these treasures are identified with magnifying-glass or handy microscope. The botanical name of them are as follows: *Chamaecyparis obtusa, Cryptomeria japonica, Torreya nucifera, Taxus cuspidata* and *Sciadopitys verticillata* in conifer, and *Zelkova serrata, Morus bombycis, Quercus* sp., *Fraxinus* sp., *Paulownia tomentosa, Cinnamomum camphora, Diospyros kaki, Magnolia obovata, Prunus jamasakura, P. mume, Buxus microphylla* var. *japonica, Distylium racemosum, Acer* sp. and *Zizyphus jujuba* var. *inermis* in broad-leaved tree. Some foreign species, i.e., *Diospyros ebenum, Dalbergia latifolia, Pterocarpus santalinus, P. macrocarpus, Cassia siamea, Santalum album,* and *Aquilaria* sp., are identified.

K. YOSHIMURA, S. HAYASHI, T. ITOH and K. SHIMAJI: **Studies on the Improvement of the Pinning Method for Marking Xylem Growth I. Minute Examination of Pin Marks in Taeda Pine and Other Species.** Wood Research, No.**67**, 1 (1981).

In order to make an accurate estimation of the location of cambium at the time of pin insertion, pin marks left in the xylem tissue were minutely examined. The size and shape of the abnormal tissue induced by pin insertion depended on the size of needle, growth rate of trees, and the tree species. Since the abnormal tissue changed its shape and size as the cross section receded from the center, it was concluded to be necessary to use the cross section obtained from the center of pinning for correct application of the pinning method.

The site relation between cambial initials at the time of pinning and the abnormal tissue was investigated following the modified Wolter's procedure. As a result, the site of cambial initials at the time of pinning was assumed to be at the cambial-side margin of the spindle-like abnormal tissue.

K. YOSHIMURA, T. ITOH and K. SHIMAJI: **Studies on the Improvement of the Pinning Method for Marking Xylem Growth II. Pursuit of the Time Sequence of Abnormal Tissue Formation in Loblolly Pine.** Mokuzai Gakkaishi, **27**, 755 (1981).

In order to clarify the site relationship between the abnormal tissue mark in xylem caused by a pin insertion and the cambial initials at the time of pinning, the process of abnormal tissue formation was pursued microscopically by periodic observations on loblolly pine. About a week after the pinning, the gap formed by the pin insertion closed within the zone of the xylem mother-cells and the enlarging cells, and crushed and dead cells which had been in the stage of being xylem mother-cells or enlarging cells at the time of pinning looked like radially-oriented bundles of refuse in cross section. These bundles were torn apart toward the xylem and phloem sides near the cambial initials with time. From the cut ends of the xylem side, radial rows of tracheid began to proliferate toward the cambial initials. This point, where the abnormal proliferation of tracheid rows initiated, was judged to be the site of the cambial initials at the time of pinning. On the other hand, the gap became wider in the zone of secondary-wall thickening from the pressure of filled parenchymatous cells. Therefore, the cambial-side margin of this wide gap was deduced to be the site of the initiation of secondary-wall thickening.

H. KURODA, M. SHIMADA and T. HIGUCHI: **Roles of Bamboo *O*-Methyltransferase in the Lignin Biosynthesis.** Wood Research, No.**67**, 17 (1981).

Bamboo *O*-methyltransferase (OMT) was purified 97-fold by ammonium sulfate fractionation, and chromatography on DEAE-cellulose, Sephadex G-200 and -100

columns and analyzed by polyacrylamide gel electrophoresis and isoelectric forcusing. Two methylation processes, i.e. caffeate to ferulate (FA) and 5-hydroxyferulate to sinapate (SA), were demonstrated to be catalyzed by the same enzyme in the lignin biosynthesis.

Bamboo OMT catalyzed the methylation of caffeate, 5-hydroxyferulate, 3,4,5-trihydroxycinnamate, 5-hydroxyvanillin, protocatechuate, but no or little methylation of chlorogenate, isoferulate, *m*-, *p*-coumarate, 3,4-dihydroxyphenylacetate, 3,4-dihydroxymanderate, gallate, pyrocatechol, pyrocatechol phthalein, and *d*-catechin. Km values for caffeate and 5-hydroxyferulate were 5×10^{-5} and 10^{-5}M, respectively, and the former methylation was competitively inhibited by the latter phenolic substrate. The enzyme was an acidic protein with pI 4.61 at 4°C, and showed optimal pH at 8.0 with half maximal activities at pH 8.6 ± 0.2 and 6.4 ± 0.2. The ratio SA/FA in Gramineae and allied species was ca. 1.0 which was smaller than that of common angiosperm OMTs. This paper will discuss two possible regulatory mechanisms in the lignin biosynthesis which might be finely controlled by the OMT.

H. Kuroda, M. Shimada and T. Higuchi: **Characterization of a Lignin-Specific *O*-Methyltransferase in Aspen Wood.** Phytochem., **20**, 2635 (1981).

O-Methyltransferases were extracted from the differentiating xylem of 10-yr-old *Populus euramericana*. The enzymes were partially purified by ammonium sulfate precipitation, and column chromatography on DEAE-cellulose, Sephadex G200 and hydroxyapatite. The enzymes were resolved into two peaks by DEAE-cellulose chromatography, and the MWs of the respective enzymes were estimated to be 72000 and 75000 by gel filtration chromatography. The enzyme corresponding to the latter peak was unstable and thus only the former peak enzyme was characterized completely. Magnesium ions had no effect, EDTA moderately stimulated and heavy metals and SH group inhibitors strongly inhibited enzyme activity. K_m values for caffeate and 5-hydroxyferulate were estimated to be 3.8×10^{-4} and 3.1×10^{-4}M, respectively. The ratio of V_{max}/K_m for 5-hydroxyferulate was 5.4 times greater than that for caffeate. The enzyme(s) catalysing the formation of ferulate from caffeate and of sinapate from 5-hydroxyferulate were not separated during the purification or by the disc electrophoresis using polyacrylamide gel. Quercetin, cyanin and catechin were not methylated by the enzyme preparation. The *O*-methyltransferase of aspen wood, where the phenolic metabolism is almost exclusively directed to lignin biosynthesis, catalyses the methylation of both guaiacyl and syringyl lignin precursors, with preferential utilization of the latter substrate. These findings lead to the conclusion that the enzyme is a typical angiosperm-type *O*-methyltransferase related to guaiacyl and syringyl lignin biosynthesis in aspen wood.

K. INABA, Y. IIZUKA and T. KOSHIJIMA: **Acceleration of the Growth of *Basidomycetes* by the Sulfite Waste Component.** Mokuzai Gakkaishi, **27**, 231 (1981).

The LVD and LSD fractionated from the commercial sulfite solid waste have been found to accelerate the growth of mycelium of *Pleurotus ostreatus, Flammulina velutipes* and *Pleurotus cornucopiae* as in the case of *Lentinus edodes*. Compared to the yield of mycelium grown under a standard condition, the effect is the most predominant with *Pleurotus ostreatus* (2.3 times), *Flammulina velutipes* (2.1 times) and *Pleurotus cornucopiae* (3.0 times), when 1.0–1.5% LVD or LSD is added to the medium as accelerator. It turned out that saw dusts or pulp chip waste of Buna, Akashiya and a domestic hardwood mixture are available for use as the medium for culturing *Basidomycetes*. The effect of LSD for the saw dust medium was the most remarkable in 3–4% addition for *Lentinus edoles*, and 1–2%, for either *Pleurotus ostreatus* or *Flammulina velutipes*, corresponding to the observation with the naked eye of the mycelium density.

T. KOSHIJIMA, J. AZUMA and N. TAKAHASHI: **Hydrophobic Interaction of LCC Molecules Isolated from MWL of Pine and Beech Woods in an Aqueous Solution.** Proceedings, " Ekman-Days 1981 " pI:67 (1981).

Beech and pine LCCs (Lignin carbohydrate compound) extracted with an aqueous dioxane solution, particularly the carbohydrate moieties were investigated. Back-bone carbohydrate chain in beech LCC was (1→4)-linked xylopyranose polymer with a lot of branching points, having MW of $6–9 \times 10^3$ and, in pine LCC, this was (1→4)-linked glucomannan chain with many branchings, which gave MW, $1–4 \times 10^3$. In any cases, lignin fragments of a relatively small molecular weight are considered to link to backbone chain of carbohydrate as single side chains. Those LCCs were found to form micelles or aggrigates of $1–5 \times 10^5$ molecular weight in an aqueous solution by mutual hydrophobic interaction. The LCC having an ability of micelle formation was the molecule keeping a hydrophobic component, i.e. lignin moiety and the hydrophilic one, i.e. carbohydrate moiety in a ratio of approximate 1:1 within a molecule.

F. YAKU, R. TANAKA and T. KOSHIJIMA: **Lignin Carbohydrate Complex. Pt. IV. Lignin as Side Chain of the Carbohydrate in Björkman LCC.** Holzforschung, **35**, 177 (1981).

The viscosity of neutral LCC (C-1-M-I), one of the components composed of " Björkman LCC ", was determined in an aqueous solution and in the solution containing water-soluble lignin with a view to investigate the interaction of LCC with lignin due to the conformational change of the LCC. LCC with higher lignin content showed an appreciable drop in viscosity when other lignin molecules are existing in the solution as solute. That means, the conformational change of the LCC molecule

took place by the hydrophobic interaction with lignin molecules in the solution. As above fact indicates a probability that lignin binds to carbohydrate main chain as side chain, separation of monosaccharides connecting lignin at C_2 at C_3 was tried by using the Smith degradation. Mannose and glucose were found to be the carbohydrate moiety connecting lignin fragment at C_2 or C_3 from the analysis of the Smith degradation product of C-1-M-I.

T. KOSHIJIMA: **Wood as Resources and Energy Source.** Energy and Resources, **2**, 242 (1981).

Volume of a forest stand, demands for wood usage, and waste wood from forest and mills in this country have been shown and research achievements for substitute energy from those unused woody material such as alcohol production, wood liquefaction, fats and fatty oils from temperate woods, methane production from barks are described.

J. AZUMA and A. SATO, **Chemistry and Utilizations of Waste Woods and Barks.** Kagaku, Zokan (Kyoto), No.**90**, 47 (1981).

Utilization of wood wastes and barks as fuels, saccharification by hydrolysis, explosive pulping, delignification and biol. pulping of wood wastes, utilization of bark as compost or fertilizer, and cultivation of mushrooms are reviewed.

J. AZUMA, N. TAKAHASHI and T. KOSHIJIMA: **Isolation and characterization of Lignin-carbohydrate Complexes from the Milled-wood Lignin Fraction of *Pinus densiflora* Sieb et Zucc.** Carbohydr. Res., **93**, 91 (1981).

Fractions of lignin-carbohydrate complexes isolated from MWL of *Pinus densiflora* had apparent wt.-av. mol. wts. of 5000–500,000, and contained neutral sugar 38.0–73.1%, uronic acid 6.2–11.0%, and lignin 22.2–51.5%. The neutral carbohydrate residues contained L-arabinose, D-xylose, D-mannose, D-galactose, and D-glucose in the ratio 15.8–27.6 : 16.2–16.5 : 26.1–37.3 : 16.7–19.3 : 10.5–14.0; methylation and Smith degrn. indicate that the carbohydrates in the complexes are multiply branched.

A. ENOKI, Y. YAJIMA and M. H. GOLD: **Olefin Saturation and Acid Reduction of 3, 4-Dimethoxycinnamic Acid and Derivatives by *Phanerochate chrysosporium*.** Phytochemistry, **20**, 1543 (1981).

The white rot fungus *Phanerochaete chrysosporium* metabolized 3,4-dimethoxycinnamic acid in shaking and nitrogen sufficient cultures. Metabolites identified included 3-(3,4-dimethoxyphenyl)propionic acid, dimethoxycinnamyl alcohol and 3-(3,4-dimethoxyphenyl)-1-propanol. Significantly smaller amounts of veratryl and vanillyl alcohol were also present. The abundance of the propionic acid and the propanol as metabolic products indicate that olefin saturation and acid reduction

are important reactions catalysed under these conditions. Metabolites identified from the metabolism of 3-(3,4-dimethoxyphenyl)-propionic acid included the above 1-propanol as well as veratryl and vanillyl alcohol; the identification of these benzyl alcohol derivatives as metabolites suggests that α,β-bond cleavage of this substrate was proceded by alkane hydroxylation at the α-position.

A. ENOKI, G. P. GOLDSBY and M. H. GOLD: **β-Ether Cleavage of the Lignin Model Compound 4-Ethoxyphenylglycerol-β-guaiacyl Ether and Derivatives by *Phanerochate chrysosporinm*.** Arch. Microbiol, **129**, 141 (1981).

The white rot basidiomycete *Phanerochaete chrysosporium* metabolized 4-ethoxy-3-methoxyphenyl-glycerol-β-guaiacyl ether (V) in low nitrogen, stationary cultures under which conditions the ligninolytic enzyme system is expressed. 4-Ethoxy-3-methoxyphenylglycerol (XIII), guaicol and 4-ethoxy-3-methoxybenzyl alcohol (II) were isolated as metabolic products. Exogenously added XIII was rapidly converted to 4-ethoxy-3-methoxybenzyl alcohol indicating that it is an intermediate in the metabolism of V. *P. chrysosporium* also metabolized 1-(4′-ethoxy-3′-methoxy-phenyl)-2-(2″-methoxyphenoxy)-3-hydroxypropane (VI). The degradation pathway for this dimer also included initial β-ether cleavage and α-hydroxylation of the diol product 1-(4′-ethoxy-3′-methoxyphenyl) 2,3 dihydroxypropane (XI) to yield the triol XIII which was cleaved at the α,β bond to yield 4-ethoxy-3-methoxybenzyl alcohol. Finally *P. chrysosporium* also cleaved the dimer 1-(4′-ethoxy-3′-methoxyphenyl)-2-(2″-methoxyphenoxy)-1-hydroxypropane (VIII) at the β-ether linkage yielding 1-(4′-ethoxy-3′-methoxyphenyl) 1,2 dihydroxypropane (IX) which was subsequently cleaved at the α,β bond to yield II. All of the results indicate that oxidative β-ether cleavage is an important initial reaction in the metabolism of β-aryl ether lignin subsructure dimeric compounds. Metabolities were identified after comparison with chemically synthesized standards by gas liquid chromatography-mass spectrometry.

T. HIGUCHI: **Biosynthesis and Biodegrdation of Lignin.** The Ekman-Days 1981, Vol.**3**, 16, International Symposium on Wood and Pulping Chemistry, Stockholm (1981).

In the first section, differences in biosynthesis of guaiacyl and syringyl lignins in gymnosperms and angiosperms are explained in terms of the different functions of *O*-methyltransferases, *p*-hydroxycinnamate : CoA ligases and *p*-hydroxycinnamyl alcohol oxidoreductases which participate in the formation of monolignols. In addition, the role of quinonemethide intermediates in the formation of lignin-carbohydrate complexes (L.C.C.) are discussed based on the analytical results of the reaction products of the quinonemethide of guaiacylglycerol-β-guaiacyl ether with sugars, and DHP-polysaccharide complexes. In the second section, biodegradation pathways

of major substructures of lignin, such as arylglycerol-β-aryl ether, phenylcoumaran, diarylpropane-1,3-diol and resinol are presented based on the experimental results of our recent investigations.

T. HIGUCHI, M. SHIMADA, F. NAKATSUBO and T. K. KIRK: **Some Recent Advances in Lignin Biodegradation Research as Related to Potential Application.** Bioconversion and Biochemical Engineering, Vol.**1**, Symposium 2, p.205 (1981).

Lignin, a major cell wall component of woody plants, is the most abundant renewable organic material next to cellulose, and is the major source of aromatic carbon. Chemical approaches to its exploitation have met with only marginal success and it remains a grossly underutilized renewable resource. Biotechnological approaches have received little attention, due in large part to a lack of knowledge about the various aspects of the microbial metabolism of lignin. This review summarizes recent progress toward gaining that knowledge. It presents a brief overview of the chemical structure of lignin and of the new results on the microbiology and physiology of lignin degradation. It then focuses on the progress being made in elucidating the chemistry of the fungal degradation of lignin, particularly lignin model compounds, and summarizes the indicated biochemistry. Research on all aspects of lignin biodegradation is very active, and rapid advances are being realized. Potential biotechnological applications of ligninolytic systems, including production of cellulosic products, production of lignin-derived products and treatment of lignin-derived wastes, are presented and briefly discussed.

A. SATO: **Preliminary Forestry Survey for KIKORI District in Papua New Guinea.** The Tropical Forestry, No.**60**, 27 (1981). (in Japanese)

Report of the feasibility-survey for timber resources and general survey for forest products around KIKORI district, Gulf Province, is done by the author. Introductory description about Western Parts of this country and the data of trees at Veiru Creek near KIKORI at which timber resources are found economically as 16×10^5 m^3 per 3×10^4 ha. Major trees, by the way, are Taun (24%), Celtis (11%), erima (11%) and red planchonella (5%).

A. SATO: **Wood Extractives as Organic Resources.** " Chemistry on Organic Resources ", Special Issues of " Kagaku (Chemistry) " No.**90**, 176 (1981), Kagaku Dojin Publisher (in Japanese).

This special issue is edited by three persons including the author's name, and he takes mainly care of the part of Wood Resources and also describe above subject with another one which is co-written by J. Azuma who shows at his space.

M. SHIMADA, F. NAKATSUBO, T. HIGUCHI and T. K. KIRK: **L-Glutamate Repression of Biosynthesis of Veratryl Alcohol in Relation to Lignin Biodegradation in *Phanerochaete chrysosporium*.** The Ekman-Days 1981, Vol. 3, 99, International Symposium on Wood and Pulping Chemistry, Stockholm (1981).

The lignin-degrading basidiomycete *Phanerochaete chrysosporium* synthesizes veratryl alcohol as a secondary metabolite from L-phenylalanine and L-methionine via 3,4-dimethoxycinnamyl alcohol and veratrylglycerol. Study of the conversion of 3,4-dimethoxycinnamyl alcohol to veratrylglycerol and veratryl alcohol showed it to be a) catalyzed by a secondary metabolic system, b) markedly suppressed by culture agitation, c) affected by oxygen concentration, d) strongly repressed by L-glutamic acid, e) not effected by cycloheximide and f) not induced by pretreatment with the substrate of 3,4-dimethoxycinnamyl alcohol. The ligninolytic system exhibits traits a–f above. Furthermore, demethylation reaction at 4-position of veratric acid was strongly effected by agitation of the culture and oxygen concentration.

The results here suggest that some metabolic pathways involved in the biosynthetic process (anabolism) and the degradative process (catabolism) of veratryl alcohol may overlap some of those lignin biodegradations performed by this fungus studied.

M. SHIMADA, F. NAKATSUBO, T. K. KIRK and T. HIGUCHI: **Biosynthesis of the Secondary Metabolite Veratryl Alcohol in Relation to Lignin Degradation in *Phanerochaete chrysosporium*.** Arch. Microbiol., **129**, 321 (1981).

The lignin-degrading basidiomycete *Phanerochaete chrysosporium* synthesizes veratryl alcohol (3,4-dimethoxybenzyl alcohol) via phenylalanine, 3,4-dimethoxycinnamyl alcohol and veratrylglycerol. Study of the conversion of 3,4-dimethoxycinnamyl alcohol to veratrylglycerol and veratryl alcohol showed is to be (a) catalyzed by a secondary metabolic system, (b) markedly suppressed by culture agitation, and (c) strongly inhibited by L-glutamate. The amount of veratryl alcohol synthesized de novo was positively correlated with the O_2 concentration after primary growth. Other work has shown that the cinnamyl alcohol terminal residue in a lignin substructure model compound is degraded via arylglycerol and benzyl alcohol structures in ligninolytic cultures of *P. chrysosporium*, and that the ligninolytic system exhibits traits (a)–(c) above. Ligninolytic activity is also strongly and positively correlated with O_2 concentration. The results here suggest, therefore, that the actual biosynthetic secondary metabolic product is 3,4-dimethoxycinnamyl alcohol, but that this is degraded by the ligninolytic system to veratryl alcohol via veratrylglycerol. Veratryl alcohol is only slowly metabolized by the fungus, and accumulates.

F. NAKATSUBO, T. K. KIRK, M. SHIMADA and T. HIGUCHI: **Metabolism of a Phenylcoumaran Substructure Lignin Model Compound in Ligninolytic Cultures of *Phanerochaete chrysosporium*.** Arch. Microbiol., **128**, 416 (1981).

The degradation of the phenylcoumaran substructure model compound methyl dehydrodiconiferyl alcohol by the white-rot wood decay fungus *Phanerochaete chrysosporium* was investigated using culture conditions optimized for lignin oxidation. Initial attack was in the cinnamyl alcohol side chain, which was oxidized to a glycerol structure. This was subsequently converted by loss of the two terminal carbon atoms, C_{β}' and C_{γ}', to yield a C_{α}'-aldehyde structure, which was further oxidized to the C_{α}'-acid compound. The next detected intermediate, a phenylcoumarone, was produced by double bond formation between C_{α} and C_{β}, and oxidation of the C_{γ}-alcohol to an aldehyde group. Further oxidation of C_{γ} to an acid yielded the next intermediate. The final identified degradation product was veratric acid. No products from the 5-substituted aromatic ring, and no phenolic products, were found. The initial glycerol-containing intermediate was a mixture of the *threo* and *erythro* forms, and no optical activity could be found, suggesting that its formation might have involved non-stereospecific C_{α}'–C_{β}' epoxidation followed by non-enzymatic hydrolysis of the epoxide.

M. TANAHASHI, T. AOKI and T. HIGUCHI: **Dehydrogenative Polymerization of Monolignols by Peroxidase and H_2O_2 in a Dialysis Tube III. Formation of lignin-carbohydrate complexes (LCCs).** Mokuzai Gakkaishi, **27**, 116 (1981).

Coniferyl alcohol was dehydrogenatively polymerized by peroxidase and H_2O_2 in concentrated solutions of either pectin, mannan or xylan in dialysis tubes. The thermal softening points of the resulting DHP/pectin and DHP/mannan complexes shifted to higher temperaturs 15°C and 17°C) than those of pectin and mannan themselves, but the DHP/xylan complex retained the same thermal softening temperature as that of xylan. The DHP pectin complexes exhibited dielectric absorbance at about 500 Hz at 35°C due to benzyl galacturonate esters. The scanning electron micrograph of the DHP/pectin and DHP/mannan complexes had a film-like structure similar to that of middle lamella, whereas the DHP/xylan complex had a granular structure. These results indicate that LCCs were formed by dehydrogenation of coniferyl alcohol in the pectin and mannan solutions but not in the xylan solution.

H. KUTSUKI and T. HIGUCHI: **Activities of Some enzymes of lignin formation in reaction wood of *Thuja orientalis*, *Metasequoia glypotostroboides* and *Robinia pseudoacacia*.** Planta, **152**, 365 (1981).

The activities of the following five enzymes which are involved in the formation of lignin have been compared in reaction wood and in opposite wood: phenylalanine

ammonia lyase (EC 4.3.1.5), caffeate 3-*O*-methyltransferase (EC 2.1.1.–), *p*-hydroxycinnamate: CoA ligase (EC 6.2.1.12), cinnamyl alcohol dehydrogenase (EC 1.1.1.–) and peroxidase (EC 1.11.1.7). The activities of the four first-named enzymes in the compression wood of *Thuja orientalis* L. and *Metasequoia glyptostroboides* Hu et Cheng were 2.8±1.4-fold and 2.6±1.5-fold higher than those in opposite wood, respectively, whereas peroxidase had the same level of activity in either type of wood. On the other hand, no differences were observed in the activities of the five enzymes between tension and opposite woods of *Robinia pseudoacacia* L. These findings are well in accord with the chemical structure of lignin in the compression and tension woods of the three species studied: high content of lignin rich in condensed units in compression wood, and little difference in lignin between tension and opposite woods.

H. KUTSUKI, M. SHIMADA and T. HIGUCHI: **The Role of *O*-Methyltransferase in the Formation of Lignin and Lignans in the Genus *Thuja*.** Mokuzai Gakkaishi, **27**, 39 (1981).

Members of the genus *Thuja* contain lignans composed of syringyl or pyrogallol-1-methyl ether groups, such as dihydroxythujaplicatin methyl ether or dihydroxythujaplicatin. The *O*-methyltransferase (OMT) of *Thuja* species was studied here to clarify whether the methylation of 5-hydroxyferulic acid to sinapic acid is followed by coupling with coniferyl alcohol to give dihydroxythujaplicatin methyl ether, or whether dihydroxythujaplicatin is directly methylated to its methyl ether. Results estimated that OMTs do not catalyze methylation of dihydroxythujaplicatin, whereas they do convert 5-hydroxyferulic acid to sinapic acid. The same was seen with representative angiosperm (poplar) and monocotyledon (bamboo) OMTs. These results indicate that 5-hydroxyferulic acid is methylated to sinapic acid first and this product incorporated into dihydroxythujaplicatin methyl ether.

Gymnosperm OMTs studied so far methylate 5-hydroxyferulic acid only poorly, however, *Thuja orientalis* OMT from the xylem was found here to do so most efficiently among gymnosperm OMTs. In the purification procedures of *Thuja orientalis* OMT, no isozyme which methylates 5-hydroxyferulic acid specifically was found. Characterization of the *Thuja orientalis* OMT showed K_m values for caffeic acid and 5-hydroxyferulic acid of 130 μM and 330 μM, respectively, the optimum pH of 7.5–8.0, and the MW of 54000. No divalent metal ions were required. β-Thujaplicin, commonly found in *Thuja,* competitively inhibited to the same extent the OMT reactions giving ferulic acid and sinapic acid; the K_i (caffeic acid) was 170 μM. Thus, β-thujaplicin has nothing to do with the regulation of guaiacyl or guaiacyl- syringyl lignin and lignan formation. Therefore, the preferential formation of guaiacyl lignins in *Thuja* species must be mediated by other enzyme(s) except the OMTs.

H. KUTSUKI, F. NAKATSUBO and T. HIGUCHI: **A New Synthesis of Coniferaldehyde.** Mokuzai Gakkaishi, **27**, 520 (1981).

Coniferaldehyde, an important biogenetic precursor and located as an end group of lignin, was synthesized by a new simple method which gives the best yield reported so far. Tetrahydropyranyl (THP) methyl ferulate was reduced by $LiAlH_4$ to THP coniferyl alcohol, which was oxidized by activated MnO_2 to THP coniferaldehyde. The THP ether was hydrolyzed by 1N HCl to give coniferaldehyde. This method can be generally applied to the synthesis of the lignin precursors, such as *p*-coumaraldedehyde, sinapaldehyde etc.

T. KATAYAMA, F. NAKATSUBO and T. HIGUCHI: **Syntheses of Arylglycerol-β-Aryl Ethers.** Mokuzai Gakkaishi, **27**, 223 (1981).

Guaiacylglycerol-β-vanillin ether (1) which is an important intermediate in the synthesis and biodegradation of guaiacylglycerol-β-coniferyl ether (6), was synthesized from vanillin *via* β-hydroxy ester derivative (10) in 65% yield. From (1) were obtained guaiacylglycerol-β-vanillyl alcohol ether (2), β-vanillic acid ether (3), β-ferulic acid ether (4), β-coniferaldehyde ether (5), and β-coniferyl ether (6) in high yields.

Y. KAMAYA, F. NAKATSUBO, T. HIGUCHI and S. IWAHARA: **Degradation of *d,l*-Syringaresinol, a β-β′ Linked Lignin Model Compound, by *Fusarium solani* M-13-1.** Arch. Microbiol., **129**, 305 (1981).

A β-β′ linked lignin model compound, *d,l*-syringaresinol monobenzyl ether (Ib) was incubated with *Fusarium solani* M-13-1 in a shaking culture. From the culture filtrates, three compounds II, IIIb and IV were isolated and identified. Substrate Ib was oxidized at the α-position of the side chain to give a hemiketal, an α-hydroxylated compound IIA, which was then transformed to the ketoalcohol, 3-hydroxymethyl-2-(4-benzyloxy-3,5-dimethoxyphenyl)-4-(4-hydroxy-3,5-dimethoxybenzoyl)-tetrahydro furan (IIB). These products were converted to a γ-lactone derivative, 6-oxo-2-(4-benzyloxy-3,5-dimethoxyphenyl)-3,7-dioxabicyclo-[3,3,0]-octane (IIIb), via alkyl-aryl cleavage. The syringyl moiety released from II by the cleavage reaction was identified as 2,6-dimethoxy-*p*-benzoquinone (IV). Incubation of 2,6-dimethoxyphenol (V) in fungal cultures did not give the *p*-quinone IV. *d,l*-Syringaresinol dimethyl ether was not degraded and the etherated moiety of Ib was not attacked by the fungus, indicating that the degradation of *d,l*-syringaresinol was catalyzed by phenol oxidizing enzymes. The oxidation products of Ib with peroxidase/H_2O_2 was investigated and discussed in relation to the degradation products of the fungus.

S. IWAHARA, T. JOMORI, K. ISHIKI and T. HIGUCHI: **Enzymic Degradation of Side Chains of Lignin-Related Aromatic Compounds.** The Ekman-Days 1981, Vol.5, 24, International Symposium on Wood and Pulping Chemistry, Stockholm (1981).

An alcohol oxidase which specifically oxidizes α,β-unsaturated alcohols in the side chains of lignin-related monomers, dimers and high molecular weight lignins was constitutively excreted into the culture media of various *Fusarium* spp. α-Carbon in the side chain of pinoresinol and syringaresinol was oxidized by an intracellular inducible enzyme produced by *Fusarium* spp. Some properties of the enzymes are presented. And some other enzyme systems participates in the degradation of side chain of lignin-related aromatic compounds are also presented.

T. HIGUCHI: **Biosynthesis of Lignin and Tannin.** Shokubutsuseirigaku, **3**, ed. by T. Asakura Publishing Co. pp.228–241 (1981). (in Japanese)

Recent investigations on lignin and tannin biosynthesis were reviewed.

T. HIGUCHI: **Synthesis and Biodegradation of Oligolignols.** Skikoku Koenkaiho, **32**, 22 (1981). (in Japanese)

Synthesis and degradation pathways of oligolignols by *Fusarium solani* M-13-1 and *Phanerochaete chrysosporium* were reviewed.

K. SUMIYA: **The Existing State of the Utilization of Woody Resources in Japan.** Kokudo Mondai, No.**23**, 16 (1981). (in Japanese)

Recent change in supply and demand of wood in Japan and its cause are considered. It has harsh influences on rural district of Japan. A suggestion on afforestation in Japan is proposed.

I. HAGIWARA, N. SHIRAISHI, T. YOKOTA, M. NORIMOTO and Y. HAYASHI: **Homogeneous Tritylation of Cellulose in a SO_2-DEA-DMSO Medium.** J. Wood Chem. Techn., **1**, 93 (1981).

The present investigation was undertaken to see if a practical method could be developed for homogeneous tritylation of cellulose in a non-aqueous solvent of cellulose. Our new procedure of tritylation of cellulose can easily be carried out under homogeneous conditions by dissolving cellulose in a sulfur dioxide (SO_2)-diethylamine (DEA)-dimethyl sulfoxide (DMSO) solvent system, one of the non-aqueous cellulose solvents, followed by addition of trityl chloride and pyridine. This new method can avoid the time consuming pretreatment for the decrystallization of cellulose which has been necessary in the traditional procedure and can lower the reaction temperature. IR spectra of the products indicated the formation of trityl cellulose. Measurements of dielectric properties of the products confirmed

that trityl groups were selectively introduced at the primary hydroxyl groups in cellulose. This conclusion was also confirmed by a ^{1}H-NMR study in which the tritylated products was first acetylated, detritylated and then trideuterioacetylated and ^{1}H-NMR spectra were taken at each stage and examined comparatively.

M. NORIMOTO: **Wood-Bending by Microwaves.** Woodworking Machinery, No. **104**, 10 (1981). (in Japanese)

Wood bending utilizing microwave heating was reviewed.

T. MOROOKA, M. NORIMOTO, N. SHIRAISHI, T. YOKOTA and M. TANAKA: **Compatibility of Polymer Blends of Cellulose with Nylon or Polyester.** Nihon Reoroji Gakkaishi (J. Soc. of Rheology, Japan), **9**, 49 (1981). (in Japanese)

In order to clarify compatibility of cellulose caprate with nylon or polyester, dynamic mechanical measurements and optical micrographic observations were carried out. Blends of cellulose caprate with polyester showed typical features for a well-defined two-phase system. On the other hand, in the case of cellulose caprate and nylon blends, primary dispersions observed in each parent polymer did not appear separately, but instead a single peak appeared which spanned the range between the transition temperatures of the two parent polymers. This also was the case for the secondary dispersions. An optical micrograph revealed that blending of cellulose caprate with nylon were good enough compared to that of cellulose caprate with polyester. Blends of cellulose caprate with the nylon seemed to result in rather high compatibility in comparison with those of cellulose caprate with polyester.

T. OHGAMA and T. YAMADA: **Young's Moduli of Earlywood and Latewood in Transverse Direction of Softwoods.** J. Soc. of Material Sci. Japan, **30**, 707 (1981). (in Japanese)

In order to examine the effect of the structural inhomogeneity of wood on its Young's modulus, an analytical model was proposed.

The model was constructed by considering the structural arrangement of earlywood and latewood cells in the cross section of softwoods, and also the fine structure of the cell wall (Fig. 1). The Young's moduli of earlywood and latewood in the transverse direction were evaluated on the basis of Finite Element Solution for the repeating units of the model. Data on the orientation of the microfibrils and area percentage of the layers in the cell wall presented by Saeki for Japanese cypress (Hinoki wood) were adopted, and the elastic constants of the cell wall layers were determined by means of three methods shown in Table I. The results were compared with the experimental values used by Boutelje for the samples consisting of isolated tissue components made of Swedish pine-wood (Table II, III).

It was indicated that the agreement between the calculated and experimental

values was fairly good in magnitude, and the elastic anisotropy in the radial and tangential directions was affected by the geometry such as shape and size of the cell rather than the fine structure of the cell wall.

T. OHGAMA, T. MOROOKA and T. YAMADA: **Elastic Modulus of Wood as a Porous Material (Variation with Direction Relative to Annual Ring).** J. Soc. of Material Sci. Japan, **30**, 707 (1981). (in Japanese)

In this paper, the relation between the anatomical features and the elastic anisotropy in the transverse direction of softwood was investigated experimentally and numerically by using a simple model.

The cell arrangement in the cross section of wood was approximated by two kinds of porous models, which were made of an isotropic and homogeneous material. They corresponded to earlywood and latewood. Tensile tests were carried out in various directions between the two principal axes of these models. Then, the numerical values of n, which is an index of anisotropy decided by both the geometrical features of deformable unit of wood and its volume fraction, were determined. The modulus of ray tissue was calculated using the anatomical model of its fine structure.

On the basis of these experimental and calculated data, the elastic moduli in various directions of whole wood were simulated by considering wood as a complex laminate with two stages of lamination, *i.e.* a laminate of alternating layers of transversely anisotropic earlywood and latewood perpendicular to ray tissue. The mixture rule was used in order to compute the elastic modulus of this complex laminate. Young's modulus perpendicular to the grain of sugiwood and hinokiwood at any given angle to the radial direction was obtained by measurements with special u-gages designed to eliminate various errors.

From these results, it was found that the elastic anisotropy of wood was caused predominantly by the arrangement of pores and macroscopically laminated structures.

M. NORIMOTO, H. WADA, K. HASEGAWA and I. IIDA: **Wood Bending Utilizing Microwave Heating.** Nihon Reoroji Gakkaishi (J. Soc. of Rheology, Japan), **8**, 166 (1980). (in Japanese)

Wood bending utilizing microwave heating was investigated. In the first place, a creep test for *Quercus crispula* having various moisture contents during irradiation with microwave was carried out and the effect of the initial moisture content ϕ_0 on the final creep deflection y_{cf} was examined. The relation between y_{cf} and ϕ_0 was expressed by $y_{cf}=4\sqrt{\phi_0}$. In the next place, the bending quality of nine kinds of softwoods and hardwoods was compared. The rating of the bending quality was based on the radius of curvature of a bent member. The bending quality varied among the different wood species and as a rule that of hardwoods was better than

that of softwoods. *Robinia pseudo-acacia* and *Pinus taeda* could be bent to a 3 cm radius in 1 cm thickness without any compressive wrinkles and tensile failures. An attempt was also made to correlate the bending quality with the specific gravity of wood and such mechanical properties of water saturated wood specimens as modulus of elasticity, stress and strain at proportional limit and maximum load and deflection. The mechanical properties were measured by a static bending test at 20°C. A good correlation was found between bending quality and maximum deflection. Furthermore, the anatomical structure in cross section of the bent wood was examined through a microscopic examination. Regular array of cells in radial direction which is common in the untreated wood became disordered by the bending treatment, which suggests that the cell wall materials were softened remarkably during irradiation with microwave

M. NORIMOTO, T. OHGAMA, T. ONO and F. TANAKA: **Young's Modulus of Cell Wall for Coniferous Wood.** Nihon Reoroji Gakkaishi (J. Soc. of Rheology, Japan), **9**, 169 (1981). (in Japanese)

Young's modulus of the cell wall in longitudinal direction, which varies widely not only among the different wood species but also within the same species, is closely related to the bending quality of wood. In order to explain this observation, we made measurements of Young's modulus, crystallinity and microfibril angle for numerous softwood species. The experimental values of the average dynamic Young's modulus of the cell wall ranged from 4.5×10^{11} dyn/cm^2 to 6.4×10^{10} dyn/cm^2. Species having extremely low value of this modulus showed low degree of crystallinity and large microfibril angle. On the other hand, the Young's modulus of the cell wall was theoretically estimated using a cell-wall model, in which the distribution of chemical constituents and microfibril angles in the cell-wall layers are taken into account. The effects of crystallinity, microfibril angle and elastic constants of matrix on the Young's modulus of the cell wall was examined according to this theory. From these results it was proved that the Young's modulus of the cell wall depend strongly on microfibril angle and that the main reason for the variation of the Young's modulus of the cell wall and the bending quality among the different species is resulted from the variation of microfibril angle.

F. MAKI, M. NORIMOTO, T. AOKI and T. YAMADA: **Estimation of Humidity Conditions Caused by Interior Wall Materials.** Mokuzai Kogyo, **36**, 476 (1981). (in Japanese)

Both the relative humidity $H(T)$ and the temperature T in the closed steel boxes lined with various interior board materials were measured when the external temperature of the box was changed periodically in the range from 25°C to 35°C. The results showed that log $H(T)$ is a linear function of T. The slope of log

$H(T)$-T curve, B, is independent of T, and the smaller the value of $|B|$ is, the better the humidity conditions. Thus, the extent of humidity conditions caused by wall materials can be quantitatively estimated by using B. Wall materials were classified into four groups. Wood based materials resulted in superior humidity conditions, compared with synthetic and inorganic ones.

F. MAKI, M. NORIMOTO and T. YAMADA: **Relationship between Humidity Conditions and the Nature of Interior Wall Materials III.** Mokuzai Gakkaishi, **27**, 828 (1981). (in Japanese)

Measurements were made of the relative humidity in a prefabricated wooden house in which a person lived according to the schedule indicated in Figure 1. The house was lined with five mm thick plywood except for a door and windows. It was proved experimentally that the logarithm of the relative humidity log $H(T)$ in the house was expressed by a linear function of temperature T even when a dweller was present and ventilation was provided. The slope of the log $H(T)$-T curve, B, represents the extent of humidity conditions in the house, and the smaller that the value of $|B|$ is, the better are the humidity conditions. The average values of $|B|$ when a dweller was present and was absent were 82×10^{-4} and 32×10^{-4}, respectively. By substituting these values into equation (3), the humidity ranges ΔH expected in the house at respective temperature ranges ΔT were estimated.

H. SASAKI: **Utilization of Wood as an Ecological System.** Cultural Research of Forest (Shinrin Bunka Kenkyu), **2** (1), 75 (1981). (in Japanese)

Ideal relation between forests and human beings was discussed and immediate efforts to maintain a recycle system of forest resources were proposed. From this point of view, problems encountered to the forestry and forest products industry in the future of Japan were forecasted. Some reviews and discussions were made on the sub-recycle or sub-sub-recycle of forest resources in housing and paper industries and technical development with laminated wood products from low grade logs.

H. SASAKI: **Particleboard Industry in North America.** Wood Working Machinery (Mokko-Kikai), No.**104**, 21/25 (1981). (in Japanese)

Recent situation and development in particleboard industry in North America were reviewed. Several plants visited by the author were introduced and a special attention was taken to the structural flakeboard and oriented boards.

H. SASAKI: **Recent Development with Laminated Wood Products in Japan.** Proc. of the 17th IUFRO World Congress, Division 5, p.146, (1981).

It is improper that 70% of the total wood demand in Japan depends on imported wood. Japan has to improve this situation in a manner commensurate with the

maintenance of the delicate cycle of forest resources of the world. Efforts have to be made to develop processing technology for converting low-grade resources such as logs from the thinning operation of domestic plantations and imported slender larch logs into laminated wood products of higher grade. The present status of the industries of domestic laminated wood products is briefly outlined and their needs for tomorrow are shown. Finally, production technologies and practical applications of low-grade logs to parallel laminated veneer lumber are discussed as the greatest possible extension of forest products industries.

S. ISHIHARA: **Synergistic Effect of Alkali Metals on Fire Proofing Properties of Boric Acid-Containing Melamine-Formaldehyde Condensates.** J. Soc. Materials Science, Japan, **30**, 725 (1981). (in Japanese)

The durable fire-retardants based on the colloidal solution of boric acid- and alkali metal containing melamine-formaldehyde condensates (H_3BO_3·AOH·MFAC) and 10 boron-containing inorganic compounds have been applied to Hinoki (*Chamaecyparis obtusa* Endl.) sliced veneer, Lauan (*Shorea negrosensis* Foxw.) plywood, and Sugi (*Cryptomeria japonica* D. Don.) shake. The condensates were prepared by use of boric acid, hydroxide of alkali metal and melamine-formaldehyde condensation products. These boric acid- and alkali metal-containing melamine-formaldehyde condensates given clear solution in both neutral and alkaline. The borates used were the same as those appeared in a paper of M. A. Kasem and H. R. Richard.

The treatment of Hinoki sliced veneer was accomplished by soaking samples in an aqueous solution of these condensates and borates, drying at a room temperature and curing at 160°C for 30 min. The treatment of Lauan plywood and Sugi shake were done by soaking in the aqueous solution of the fire-retardants and reducing the pressure by using a vacuum pump, drying at a room temperature for 1 month, and then curing at 160°C for 30 min.

The effects of alkali metal kind and of varying ratio of fire retardant components in treating solutions on the fire-proofing efficiencies of Hinoki sliced veneer, Lauan plywood, and Sugi shake were discussed. Boric acid-containing melamine-formaldehyde condensates combined with alkali metals imparted excellent fire-proofing resistance to wood and plywood. Satisfactory fire-proofing efficiencies can be obtained in Hinoki sliced veneer, Lauan plywood, and Sugi shake at resin content as low as 5–10%. The overall afterglow of the treated samples depended on the competition between the inhibiting effect of boron and the enhancing effect of alkali metals.

S. ISHIHARA: **Fire Retardant Particleboards by Boric Acid and Lithium Compounds.** J. Soc. Materials Science, Japan, **30**, 731 (1981). (in Japanese)

Particleboards were manufactured with adhesives containing fire-retardant

chemicals. The physical and mechanical properties, and fire resistance properties of the boards were determined and discussed. The fire-retardant chemicals used were boric acid, lithium hydroxide, lithium dihydrogenphosphate and phosphoric acid, and the adhesive was urea-melamine-formaldehyde resin. The fire-retardant adhesive containing boric acid was stabilized by the addition of lithium hydroxide and lithium dihydrogenphosphate. The fire-retardant adhesives imparted excellent fire resistance to the particleboard. The fire-retardant particleboard containing 12–15% resin in oven dry wood particles passed 1st–2nd class extinguishments by JIS A 1322 and the board containing 6–12% resin also passed 2nd–3rd class extinguishments. Increasing the resin content in oven dry wood particles resulted in an effective increase in internal bond strength as well as MOR, a remarkable decrease in thickness swelling in water, and a slight increase in the equilibrium moisture content. Excepting a few results, the internal bond strength and the MOR of the fire retardant particleboards were greater than those of the untreated one, and the thickness swelling of the fire retardant particleboards in water was smaller than that of the untreated one.

T. HAYASHI and H. SASAKI: **Time dependence on Fatigue Strength of Timber Butt-Joints with Metal Plate Connectors.** J. Soc. Materials Science, Japan, **30**, 697 (1981). (in Japanese)

Partly pulsating tension load with the frequency range of 1 Hz to 16.7 Hz was applied to timber butt-joints with metal plate connectors. The time dependent effect on fatigue strength was discussed with respect to the relation between cycles to failure (N) and loading components, *i.e.*, repetitive load (P_r) and constant load (P_c). The results obtained are as follows;

(1) N obtained by partly pulsating tests at 16.7 Hz and 10 Hz did not depend on P_c but dominantly on P_r, when the sum of P_c and P_r was less than 70% of the static strength (P_0) and P_r was greater than the fatigue limit (P_e).

(2) The failure mode of the joints in partly pulsating tests was mostly the withdrawal of teeth of the connector. This tendency was observed only in high stress levels of pulsating tests.

(3) In lower frequency tests at 5 Hz and 1 Hz, N decreased to 1/2 (5 Hz) and 1/3 (1 Hz) of the value of N obtained in 10 Hz tests, when P_r/P_0 was from 0.4 to 0.6 and the sum of P_c and P_r was 750 kg.

M. MASUDA, T. FUYUKI, S. TAKINO and H. SASAKI: **Bending Fatigue Characteristics of Stressed-Skin Panels.** J. Soc. Materials Science, Japan, **30**, 691 (1981). (in Japanese)

Bending fatigue is one of the important factors which must be considered in designing stressed-skin panels. In the present study, bending fatigue tests were

carried out on stressed-skin floor panels with glued plywood or particleboard skin under concentrated cyclic load. The function of repeated load was sinusoidal and the minimum load was 5 kgf. There were several failure modes both in static and fatigue tests. The order of the change in failure modes with increasing number of load repetitions in the fatigue test was the same as that with increasing load in the static test. The ratio of the fatigue strength at 10^6 cycles to the static strength (RFS) was 43–54%, and RFS of delamination of glue line between frame and skin was also nearly the same. Although both plywood-skin panels (PL) and particleboard-skin panels (PB) have nearly the same rigidity of flexure, the static and fatigue strengths of PB were merely 50–65% of those of PL. The fatigue strength of wet PB-panels was 17% lower than that of air-dried PB-panels. The increase of deflection under repeated load was also observed. A sudden increase of deflection was caused by sudden propagation of crack in glue line between frame and skin. Therefore, the delamination of glue joint between frame and skin by fatigue is one of the most important factors to be considered for designing of stressed skin panels.

M. TAKAHASHI, K. NISHIMOTO, T. AKADA and S. KASHIWAZAKI: **Survey on Decay and Termite Attack in Houses by Japanese Traditional Timber Construction after Thirty-Six Years Service Time.** Mokuzai Hozon (Wood Preservation), No.**18**, 13 (1981). (in Japanese)

Survey on decay and termite attack was carried out in sixteen houses which were built at Yokkaichi City, Mie Prefecture, by Japanese traditional timber construction and had been serviced for thirty-six years. Degree of timber deterioration (DTD), expressed as percentage volume/volume ratio, was measured for sill, floor post and sleeper. Average DTD-values were 37% for sill, 26% for floor post and 11% for sleeper. As generally recognized, DTD in kitchen and washroom were the highest. On the other hand, DTD in drawing- and sitting-rooms were unexpectedly lower. This is undoubtedly due to the different humidity conditions in these parts.

Based on the results obtained, different extent of preservative treatment in several parts of house is suggested for best cost-effectiveness.

M. TAKAHASHI: **Bending Creep Test of Plywoods under Long Term Exposure to Fungal Attack.** The International Research Group on Wood Preservation, Document No: IRG/WP/2163 (1981).

For the evaluation of the durability of structural plywoods and preservative efficacy, a method coupling bending creep test and decay test was proposed. Experimental blocks were impregnated with distilled water and inoculated with mycelial fragments of test fungus. Decay chamber consisting of fittingly-designed metal frame and polyethylene bag was devised. The chamber containing inoculated block

and water were plugged with porous silicone plug. Weight was hanged from the center of block. The deflection at the center of span was measured with a gauge sensor connected with a recorder. From the results of preliminary experiment, using TBP (Tribromophenol)-treated plywoods and *Tyromyces palustris* (brown rot fungus), the method is promissing for the above-mentioned objects.

S. AMEMIYA and M. TAKAHASHI: **Knowledge on Preservative Treatment of Wood.** in " Mokuzai-hozon no Chishiki (Knowledge on Wood Preservation) ", p.95, ed. Japan Wood Preserving Association, 255pp, Tokyo (1981). (in Japanese)

Fundamental knowledge on preservative treatment process of wood is described. Theory on liquid penetration into wood, conditioning of timber, comparisons of different methods of treatment and properties of preservative-treated wood are included.

K. NISHIMOTO: **Wood Preservation in New Zealand.** Mokuzai Hozon (Wood Preservation), **19**, 22 (1981). (in Japanese)

Extracts from the lecture given at the 3rd ordinary general meeting of Japan Wood Preserving Association in Tokyo. Outlines of wood preserving industry in New Zealand are mentioned in relation to timber production, specifications for timber preservation and others.

K. NISHIMOTO: **Present Status of Wood Preserving Industry in New Zealand.** Mokuzai Kogyo, **36** (12), 25 (1981). (in Japanese)

With referring to timber production as a background of wood preservation, some aspects on wood preservation are discussed: variety of wood preservatives and treating processes in accordance with commodities of products, the role of Timber Preservation Authority which is an organization to secure and maintain a high standard of wood preservation, and other related matters.

K. TSUNODA: **Recent Trends in the Research on Forest Products in New Zealand.** New Lumber Man, **11** (39), 9 (1981). (in Japanese)

Research organization, Forest Research Institute located in Rotorua, in which main investigations on forest products are conducted is briefly introduced. Some topics of each research section of the institute outlined.

K. TSUNODA: **Wood-boring Habit of Shipworms.** Mokko Kikai, **107**, 9 (1981). (in Japanese)

Wood-boring mechanism and activity are described in relation to the specialized morphological features of shipworms. Growth rates of two shipworm species and digestibility of wood substrate are reviewed with some references.

K. TSUNODA: **Shipworm Problem in Japan.** Mokko Kikai, **108**, 5 (1981). (in Japanese)

Logs stored in Japanese sea waters are exposed to the risk of shipworm attack, but only a little attention is being paid to control the pests. Summarized results on distribution and breeding season of shipworms in Japan and possible preventive counterplan are shortly discussed.

R. IWATA and K. NISHIMOTO: **Studies on Autecology of *Lyctus brunneus* (Stephens). I. Mass Culture of *Lyctus brunneus*.** Mokuzaikenkyu·Shiryo (Wood Research and Technical Notes), **15**, 34 (1980). (in Japanese)

An attempt to rear powder-post beetles, *Lyctus brunneus* (STEPHENS), in a mass culture scale was carried out successfully, and some improvements of technique and knowledges were obtained.